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Notes on the Biology of a Parasitic Bee, Isepeolus viperinus (Hymenoptera, Anthophorinae) [1]

By CHARLES D. MICHENER [2]

The purpose of this paper is to present information on the biology of the South American parasitic bee, *Isepeolus viperinus* (Holmberg). The observations are fragmentary but, in view of the interesting structural and behavioral parallelisms that occur among various parasitic bees, it seems worth publishing them, especially since very little has been known previously of the biology of any Protepeolini.

The so-called parasitic bees that inhabit nests of solitary bee hosts are inquilines after the manner of cuckoos. They lay their eggs in the cells of the host; each larva destroys the egg or young larva in a cell of the host, then eats the food stored by the host. When a parasite locates a host nest, she revisits it from time to time in order to lay an egg in each cell, or at least in more than one cell. Even though the parasites occur in

[1] Contribution number 958 from the Department of Entomology, University of Kansas, Lawrence, Kansas.

[2] The field work for this study was possible thanks to a John Simon Guggenheim Memorial Fellowship and aid kindly made available by the Campanha Nacional de Aperfeiçoamento de Pessoal de Nível Superior, Rio de Janeiro; the Conselho Nacional de Pesquisas, Rio de Janeiro; and the Rockefeller Foundation, New York. In particular, thanks are due to Father J. S. Moure for the use of facilities of the Secção de Zoologia, Faculdade de Filosofia, Universidade do Paraná, Curitiba, Paraná, Brazil, and for identification of the bees concerned. Early completion of the manuscript and figures was made possible by a grant from the National Science Foundation.

different families, they exhibit a remarkable series of parallelisms. Some of those relating to adult morphology have been treated by Grütte (1935), Michener (1944), and others. A most remarkable parallelism concerns the first stage larva, which in various parasites is equipped with an enormous head and jaws which are used to destroy the egg or young larva of the host. This modification occurs in such parasites as *Coelioxys* (Megachilidae), *Melecta, Oreopasites, Epeolus, Triepeolus,* and *Nomada* (Anthophorinae). It is possible that this character is an indication of phylogenetic relationship of the last three, but must have arisen independently in *Coelioxys* and *Melecta,* and probably in *Oreopasites.* Another parasitic bee, *Stelis,* however, has nearly normal first stage larvae. It is interesting to find that *Isepeolus* has a large head and jaws in this stage, just as do its parasitic relatives in the Anthophorinae.

The genus *Isepeolus* has been recorded as a parasite of *Colletes* previously (Claude-Joseph, 1926; Ruiz, 1942, 1944, under the name *Epeolus luctuosus* Spinola), but information on immature stages has been limited to notes on the mature larva by Claude-Joseph.

The observations here recorded concern its parasitism of *Colletes kerri* Moure. The ethology of this species has been discussed elsewhere (Michener and Lange, 1957).

Among 25 occupied cells of *C. kerri* collected from nests in an earth bank at Araucaria, Paraná, Brazil, on January 13, 1956, 6 were occupied by cocoons of *Isepeolus,* the others by pupae of the *Colletes.* The *Isepeolus* cocoons are 11 to 12 mm. long, 6 mm. wide, strong, firm, made of coarse brown fibers sometimes as much as .02 mm. in diameter, criss-crossed, fused at points of crossing. These form an outer layer separable with difficulty from a second layer of finer fibers partially imbedded in an amorphous membrane. This layer is easily separable from a third which is similar to the second. The fourth and innermost layer, separable with difficulty from the third, is very thin, almost without fibers or with only very fine pale ones, and is thus mostly amorphous material. It is very smooth and shining on the inner surface except near the anterior end where it is more

fibrous, less smooth, and with some open interspaces among the fibers. The thickness of the whole cocoon wall is about .28 mm. The outside of the cocoon is fairly uniformly covered with a layer of fecal matter and perhaps unused pollen. This layer is .1 to .2 mm. thick, and blackish; separate fecal pellets cannot be recognized.

At the time that these cocoons were collected one adult was already chewing its way out through one end of its cocoon. Others were still pupae, but all had emerged by January 25.

Other observations on the relations between *Isepeolus viperinus* and its host were made in a series of banks near Curitiba, Paraná, Brazil, which are termed for our purposes the Barigui roadside banks. They are described in detail by Michener, Lange, Bigarella, and Salamuni (1958). On February 26, a female *Isepeolus viperinus* was seen to enter a known nest of *Colletes kerri*. The nest was left undisturbed, but on March 4 it was excavated. It contained two cells, both of which were occupied by young *Isepeolus* larvae. The latter were straight (unlike the curled *Colletes* larvae) and floated at the surface of the semiliquid provisions. They had killed the *Colletes* larvae, but the remains of the latter were uneaten in the mass of provisions; apparently *Isepeolus* larvae do not eat those of their host.

A young *Isepeolus* larva is shown in fig. 1, with a young *Colletes* larva drawn to the same scale in fig. 2. The two drawings were traced from a photograph of living larvae removed from the cells. The young larva of *Isepeolus* is remarkable for being nearly straight, the body with thick projecting lateral folds, especially posteriorly, which disappear in larvae of the same stage which have fed and are more distended. The body is remarkable among Anthophorinae for having a few hairs, especially in the anterior half. The large, depressed, heavily sclerotized head is also rather hairy. Sclerotization extends back as a spreading shield over the anterior part of the prothorax, especially ventrally, as shown in figs. 3 and 4, where membranous areas are stippled. The pointed labrum, relatively long antennae, absence of palpi, and the large sickle-shaped

mandibles are noteworthy features. However, the fusion of the labium, maxillae and hypopharynx to form an undivided ventral plate which is completely fused with the head capsule and has the salivary opening exposed on its ventral surface is a most remarkable modification of the pattern seen in related nonparasitic Anthophorinae (e.g., *Anthophora,* see Michener, 1953). A deep midapical emargination in this plate is surrounded by downflexed margins (fig. 5). The posterior tentorial pits are reduced to a pair of inconspicuous depressions, from which exceedingly slender tentorial rods extend anteriorly; no tentorial bridge was seen, nor were anterior tentorial pits located.

The head is so differently modified from that of *Oreopasites* (Rozen, 1954), another parasitic anthophorine whose young larval head has been studied with some care, that it may be that the head enlargement and sclerotization in *Oreopasites* and *Isepeolus* larvae have been independent. In *Oreopasites* the labrum is deeply bifid, the antennae and palpi are small but recognizable and the maxillary and labial area is separated from the rest of the head. These are primitive features which agree with bee larvae in general. Hence it is reasonable to state that the primary larvae of *Oreopasites* are less specialized than those of *Isepeolus*. Unfortunately, those of other parasitic Anthophorinae have not been described in sufficient detail to permit comparison.

One might imagine that larvae so modified could only kill the egg or larva of the host and could not feed on the stored food. This is not the case, for one small larva, presumably first stage, had the body distended with pollen.

Finally, it should be noted that a prepupa of *Isepeolus viperinus* was found in a cocoon in the nest of an unknown species of *Colletes* (not *kerri*) near Restinga Seca, 20 km. east of Palmeira, Paraná, Brazil, on January 27, 1956. This prepupa pupated in mid-February and emerged in the laboratory in early March. Apparently this individual belonged to a population not synchronized with *Colletes kerri* but rather with its own host.

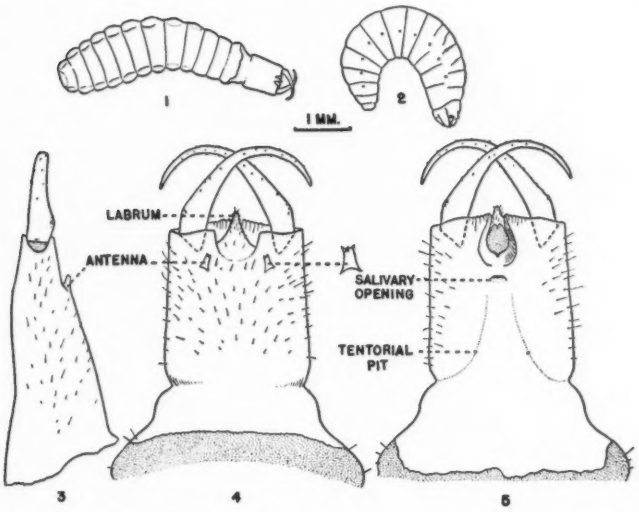

FIG. 1. Young (probably first stage) larva of *Isopeolus viperinus* (Holmberg), dorsal view.
FIG. 2. Side view of larva of the same age of the host, *Colletes kerri* Moure.
FIGS. 3–5. Lateral, dorsal and ventral views of head of young larva of *Isopeolus viperinus* (Holmberg).

Morphologically it agreed with specimens reared from nests of *C. kerri*.

As the pupa of *Isepeolus* has not been described, the following notes may be useful: No pubescence; no spines on coxae or elsewhere; a pair of tubercles on vertex near ocelli; a pair of large tubercles behind middle of mesoscutum. This pupa, as can be seen from the study of bee pupae by Michener (1954), has fewer spines and projections than any other bee pupa known. Perhaps this is because the adult is largely devoid of long hairs; in the paper mentioned above it is suggested that pupal spines serve principally to provide space for the development of the long hairs characteristic of most nonparasitic bees.

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Laboratory Training Courses

A schedule of the Laboratory Refresher Training Courses that will be given by the Laboratory Branch of the Communicable Disease Center during the period September 9, 1957 to March 28, 1958 has been issued. About twenty different courses on laboratory diagnoses of the various viral, bacterial, rikettsial, fungous, protozoan, and other parasitic diseases of man and animals are included. Each course runs from one to four weeks at designated periods; a few are repeated. For detailed information, and for application forms write to the Laboratory Training Services, Communicable Disease Center, U. S. Public Health Service, P.O. Box 185, Chamblee, Georgia.

Redescriptions of Ewing's Oribatid Mites, III—Family Eremaeidae (Acarina: Oribatei) [1]

By Tyler A. Woolley, Department of Zoology, Colorado A. & M. College, Fort Collins, Colorado

This paper delineates several redescriptions of oribatid mites, the original accounts of which were made by the late Dr. Henry E. Ewing. The article is a sequential part of a series proposed by Dr. E. W. Baker of the U. S. National Museum. The writer follows Ewing's descriptions as far as possible, but uses modern acarological terms.

Family Eremaeidae Willmann, 1931

According to Willmann (1931) this family of aptyctimous mites is characterized by the lack of pteromorphae, legs shorter than the body and leaf-like or ridge-like lamellae. Legs III and IV are usually inserted at the lateral margins of the hysterosoma.

The first three species redescribed below are representatives of the genus *Lucoppia* Berlese, 1908, in which the narrow, ridge-like lamellae converge, the pseudostigmatic organ is capitate, with a globe on a short, thin stalk. The last species discussed in this paper is in the genus *Eremaeus* Koch, 1836, which is characterized by reduced, parallel lamellae, short tarsi with three claws and apodemata IV fused into a sclerotized band which surrounds the genital aperture.

Lucoppia magnipilosa (Ewing), 1909. (Figs. 1, 2)

Type: *Damaeus magnipilosus* Ewing, 1909, p. 130.

Description: Olive brown in color, integument rough, with small, raised kernels. Propodosoma triangular (specimen tilted on slide), rostrum rounded anteriorly; rostral hairs simple, incurved at tips, inserted half their lengths posterior to rostral tip. Lamellae not noticeable except as slight ridge on right

[1] Research supported by a grant-in-aid from the National Science Foundation.

side. Lamellar hairs a third longer than rostral hairs, erect and inserted two-thirds their lengths directly posterior to rostral hairs. Interlamellar hairs simple, about same size as lamellar hairs, erect, inserted between pseudostigmata. Pseudostigmata cylindrical, low, slightly raised above surface of propodosoma, cornuate beneath. Pseudostigmatic organs small, erect, with narrow, short peduncle and globose head. Tectopedia I lateral, between levels of pseudostigmata and lamellar hairs.

Hysterosoma oval, wider anteriorly in tilted specimen, longer than broad. Dorsum with eleven pairs of long, fine, simple setae. Each seta finely serrate as shown in fig. 1. Two posterior median pairs of setae shorter than others. Ewing's description states: "At the posterior margin of the abdomen are situated two pairs of short, stout, fusiform bristles, characteristic of this species; the upper two are about twice as long as the lower two, and both pairs are inclined away from the median plane." In the specimen from which this description is constructed these dorsal hairs are fine and not stout. There are, however, two short, fusiform adanal hairs on the venter, which Ewing may have viewed from above, but none of the setae on the dorsum is stout.

Camerostome oval as seen in tilted specimen, with two simple bristles posterior to chelicerae. Other bristles as shown in fig. 2. Ventral plate shield shaped, anterior margin of shield formed by curved apodemata IV. Genital opening oval, nearly three times its length from anal aperture, anterior margin contiguous with curved front margin of ventral plate adjacent to apodemata IV. Each genital plate longer than broad and with five simple setae inserted closer to lateral margin than to medial (fig. 2); g:1 inserted on anterior margin of genital plate; g:5 inserted in middle of posterior edge; g:2, g:3, g:4 and g:5 equidistant from each other, a slightly wider separation between g:3 and g:4. Anal aperture nearly square; anal plates nearly three times as large as genital plates, longer than broad, with two anal setae; a:1 inserted laterally on plate, a:2 shorter and closer to median and posterior margin of plate (fig. 2).

According to Ewing the anterior pair of legs are as long as entire body, the leg segments less swollen than in other species. He describes all legs with stout, curved, pectinate hairs and leg IV as the longest of the legs.

Length 725 μ, hysterosoma 528 μ; width 428 μ.

Discussion: The original description by Ewing (1909a) is slightly different in some respects from the current redescription. The specimen described above is not the type, but bears the same identification as the type. According to Ewing the type species was collected by J. D. Hood at Urbana, Illinois, under the bark of soft maple. The specimen described above is one collected by C. R. Crosby at Columbia, Missouri, and mounted June 19, 1908.

Lucoppia curviseta (Ewing), 1909. (Figs. 3, 4)

Type: *Notaspis curviseta* Ewing, 1909, p. 105.

Description: Dark reddish brown, integument thick and hard. Propodosoma narrowly triangular, about one third as long as body, expanded laterally in outline by projection of tectopedia I and II. Rostrum rounded; rostral hairs simple, erect, about half as long as lamellar hairs, inserted three-fourths their lengths from tip of rostrum at lateral margins. Lamellae narrow, convergent bands or ridges on surface of propodosoma, extended from base of pseudostigmata to level of anterior margin of tectopedia I, expanded distally for insertion of lamellar hairs. Lamellar hairs about as long as propodosoma, finely serrate (Ewing states: "pectinate"), directed forward. No translamella. Interlamellar hairs about three-fourths as long as lamellar hairs, simple, erect, but curved outward and upward, inserted near lamellae, antero-mediad of pseudostigmata. Pseudostigmata small, circular pits, slightly larger in diameter than width of lamella. Pseudostigmatic organ short, directed antero-laterad, with straight, narrow pedicel, a spherical head at level of tectopedia II. Tectopedia I and II as shown in fig. 3.

Hysterosoma subglobose, slightly broader in front, anterior margin indented laterally to form a small scallop around insertion of first pair of setae directly behind tectopedia II; first

pair of setae straight, directed laterad; dorsum with thirteen pairs of simple, curved setae (Ewing says: "pectinate"). Four pairs of areae porosae, one pair posterior to shoulder of hysterosoma, three pairs postero-lateral in position (fig. 3). A glandular fissure postero-laterad of fourth pair of hysterosomal bristles.

Camerostome subtriangular, two setate immediately posterior to chelicerae. Other setae as in fig. 4. Apodemata I and II long, narrow, directed mediad; apodemata III and IV short, curved, extended mediad a fourth the distance to genital opening. Anterior margin of genital aperture contiguous with apodemata II, opening nearly square in outline, about three times its length anterior to anal aperture. Each genital plate rectangular, with straight, medial margin, rounded lateral corners; four short, fine genital setae on each plate; g:1 and g:2 anterior, g:3 and g:4 posterior (fig. 4). Anal aperture nearly three times as large as genital opening, somewhat polygonal in outline. Anal covers with two fine, curved hairs inserted closer to medial margin than to lateral. Two pairs of stout, fusiform, adanal setae, one at postero-lateral corner of anal aperture, second pair posterior to aperture near posterior margin of ventral plate, projected posteriorly beyond margin of hysterosoma.

Legs subequal, posterior pair not extended beyond hind margin of hysterosoma.

Length 766 μ, hysterosoma 566 μ; width 533 μ.

Ewing (1909b) states that several specimens of this species were collected at Arcola and Homer, Illinois.

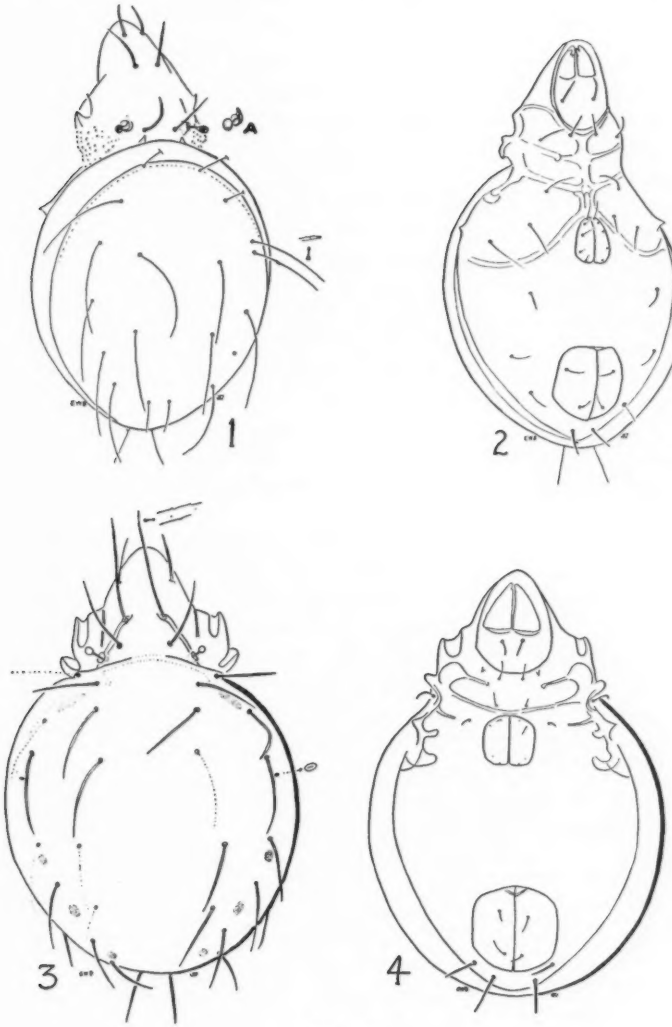
EXPLANATION OF FIGURES

FIG. 1. *Lucoppia magnipilosa* (Ewing), 1909, from dorso-lateral aspect; A. pseudostigmatic organ (after Ewing 1909); legs omitted.

FIG. 2. *Lucoppia magnipilosa* (Ewing), 1909, from ventral aspect; legs omitted.

FIG. 3. *Lucoppia curviseta* (Ewing), 1909, from dorsal aspect; legs omitted.

FIG. 4. *Lucoppia curviseta* (Ewing), 1909, from ventral aspect; legs omitted.



FIGS. 1-4.

Lucoppia boletorum Ewing, 1913, p. 120. (Figs. 5, 6)

Description: Light yellowish brown. Propodosoma longer than broad, rostrum blunt. Rostral hairs inserted in slight prominences a third their lengths from rostral tip. Lamellae less than half the length of propodosoma, low sclerotized ridges apparently extending to pseudostigmata, but interrupted by insertion of interlamellar hairs. Lamellar hairs pectinate, curved; inserted in low crescentic pits at anterior end of lamellae, reaching nearly to insertion of rostral hairs. Interlamellar hairs pectinate, divergent, a third longer than lamellar hairs, inserted in slightly curved, medial projections of lamellae, closer to pseudostigmata than to lamellar hairs. No translamella. Pseudostigmata cup-like; pseudostigmatic organs short, with narrow pedicel and subglobose, simple head.

Hysterosoma somewhat oval (except for broken dorsum on right side), surface irregular, but not pitted; dorsum with eleven pairs of slightly pectinate, curved setae (fig. 5). Areae porosae as shown in fig. 5.

Venter misshapen due to breakage of specimen. Apodemata I curved around base of camerostome; apodemata II directed medio-posteriorly from between tectopedia I and II. Apodemata III nearly horizontal at level anterior to genital aperture, not extended to margin of latter. Genital opening about two and one-half times its length from anal aperture, rounded; genital covers with straight medial margins, rounded laterally; genital setae not visible, a single setal insertion in postero-lateral corner of left cover. Anal opening about twice the size of genital opening, each anal cover with a single visible seta. An adanal seta adjacent to postero-lateral margins of anal aperture.

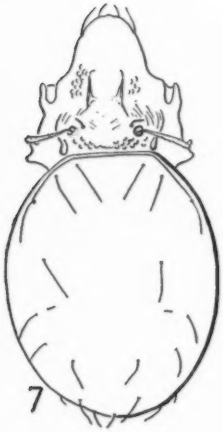
EXPLANATION OF FIGURES

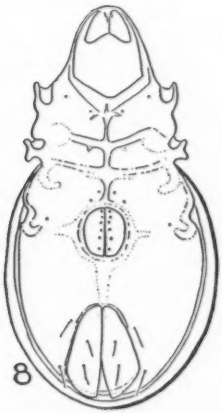
FIG. 5. *Lucoppia boletorum* Ewing, 1913, from dorsal aspect, hysterosoma broken on right side; legs partially shown.

FIG. 6. *Lucoppia boletorum* Ewing, 1913, from ventral aspects; legs omitted.

FIG. 7. *Eremaeus brevitarsus* (Ewing), 1917, from dorsal aspects; legs omitted.

FIG. 8. *Eremaeus brevitarsus* (Ewing), 1917, from ventral aspect; legs omitted.





FIGS. 5–8.

Length 614 μ, hysterosoma 470 μ.

Ewing (1913) states that this species was collected by J. E. Guthrie at Jordan, Minnesota.

Discussion: According to Ewing (1913) this species is similar to *L. pilosus* (Banks), but he differentiates *L. boletorum* on the basis of an almost circular hysterosoma and shorter lamellar hairs. The fact that the specimen of the latter species is broken makes exact comparisons difficult.

Eremaeus brevitarsus (Ewing), 1917, nov. comb. (Figs. 7, 8)

Cotype: *Damaeus brevitarsus* Ewing, 1917, p. 164.

Description: Propodosoma large, bluntly triangular in outline, narrower than hysterosoma and about two thirds as long, with small tubercles on lateral and posterior surfaces (fig. 7). Rostrum broad and blunt, rostral hairs inserted in slight notches at lateral edges of propodosoma approximately half their lengths from anterior tip. Lamellae small, elongated, triangular prominences, about as long as rostral hairs, located on dorsal surface of propodosoma, with anterior cusp that projects above surface of propodosoma. Lamellar hairs short, about one-fourth as long as lamellae, each inserted in tip of anterior lamellar cusp and slightly decurved. Translamellae reduced to small medial projections on inner edges of lamellae. Interlamellar hairs stouter than lamellar hairs, but about same length, pectinate, inserted antero-mediad of pseudostigmata. Pseudostigmata circular and pit-like, as wide as half the length of interlamellar hair, nearly three times their diameters from anterior margin of hysterosoma. Pseudostigmatic organ elongate, club-like and pectinate, extending almost directly laterad from pseudostigmata.

Tectopedia I prominent, posterior to level of lamellar hairs, but directly laterad of lamellae. Tectopedia II a prominent, notched lateral tubercle at postero-lateral angle of propodosoma between legs II and III.

Hysterosoma longer than broad, swollen and slightly oval in outline, truncate anteriorly, anterior margin apparently flattened behind propodosoma, shoulder regions sclerotized; nine pairs of fine, dorsal setae; integument smooth (fig. 7).

Posterior margin of camerostome angular; setal insertions at level of tectopedia I and medial. Apodemata II and III transverse bars, each ending in curved, sclerotized coxal insertions; apodemata IV coalesced with sclerotized margin of genital aperture. Two pairs of setal insertions anterior to genital aperture on each side of sclerotized bar between apodemata III and IV, a single setal insertion mediad of coxal insertion IV. Genital aperture oval in outline, surrounded by sclerotized ring formed by apodemata IV; each genital cover subrectangular, with six genital setae in a row near medial edge of cover. Anal opening trapezoidal, each cover somewhat triangular, opened slightly in cotype specimen (fig. 8), with two setae; two pairs of adanal setae, fine, simple, subequal in length.

Ewing (1917) describes the legs of this species as follows: "Legs . . . with short, globose tarsi; femora swollen but not globose though pedicellate at their bases. Anterior pair of legs extending beyond the tip of the rostrum by about two thirds their length; tarsi slightly shorter than the tibiae; tibiae each with distal tubercle and long tactile hair which extends beyond the tip of the tarsus. Tarsi of posterior legs strongly globose scarcely two thirds as long as the tibiae; tibiae not globose, bearing each a very long tactile hair distally which extends beyond the tips of the tarsi. Ungues of all tarsi unequal."

Length 580 μ; width 300 μ.

Ewing mentions that a single specimen was found by him beneath an old piece of wood at Ames, Iowa.

Discussion: Two discrepancies exist between the Ewing's original description and the cotype described above. Ewing indicates the lamellar hairs as large, straight, simple bristles which extend beyond the rostrum. The pencil drawing of the cotype indicates these as short and decurved. Ewing's original illustration shows four setae in the shoulder region; the cotype exhibits three. Minor differences in the lamellae also exist as illustrated here and as drawn by Ewing.

This species resembles *Eremaeus foveolatus* Hammer, 1952, but differs in the shorter length of the interlamellar hairs, lack of pits on the hysterosoma and the shorter, cusped lamellae.

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Nomenclature Notice

All comments relating to the following should be marked with the Commission's File Number, and sent to Francis Hemming, 28 Park Village East, Regent's Park, London N.W.1, England.

Dictyoploca Jordan, 1911, validation of (Order Lepidoptera) (File No.: Z.N.(S.) 1072).

Staphylinus Linnaeus, 1758, designation of *Staphylinus erythropterus* (emend. of *erytropterus*) Linnaeus, 1758, as type species of (Order Coleoptera) (File No.: Z.N.(S.) 242).

Anopheles Meigen, 1818, designation of type species for, in harmony with accustomed usage (Order Diptera) (File No.: Z.N.(S.) 1165).

picta Walckenaer, 1802 (Aranea), validation of, and of **Theridium** (emend. of Theridion) Walckenaer, 1805, validation of (Class Arachnida) (File No.: Z.N.(S.) 1006).

For details see: Bull. Zool. Nomencl. Vol. 13, Double-Part 2/3.

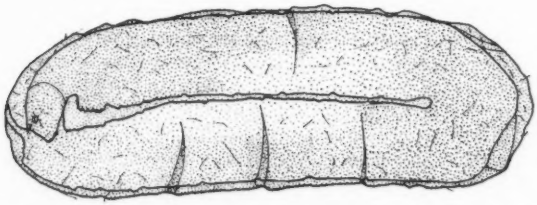
Toxorhynchites Theobald, July 1901, validation if (Order Diptera) (File No.: Z.N.(S.) 1166.

For details see Bull. Zool. Nomencl. Vol. 13, Part 4.

First Record of Endochironomus subtendens (Townes) Larval Overwintering Cocoons from North America (Diptera: Tendipedidae) [1]

By PHILIP A. BUSCEMI, Department of Biological Sciences, University of Idaho

During the course of a year-round study of the bottom fauna of Parvin Lake, Colorado (located in Larimer County at an altitude of 8200 feet), an unusually large number of overwintering cocoons of *Endochironomus subtendens* [2] larvae were collected from the plant detritus of *Elodea canadensis* in the inlet bay. To date, they have been reported only four times from certain European lakes: by Harnish (1922) from a pond of the Silesian plain, by Alm (1922) from Yxtasjön in central Sweden, by Decksbach (1933) from the Russian Pereslawskoje Lake, and by Thienemann (1954) from some north German lakes. This, then, is the first North American record for such overwintering cocoons of *Endochironomus.*



Overwintering cocoon of *Endochironomus subtendens,* × 20

Cocoons were collected by the writer as early as October 20, 1952, but the great majority were taken between November 28, 1954 to May 8, 1955. Most of the cocoons were found at depths of 0.3 to 3.0 m. They thus occurred over a slightly

[1] Contribution No. 29, Limnology Laboratory, Dept. of Biology, University of Colorado.

[2] Kindly identified by W. W. Wirth, U. S. National Museum.

greater depth range than that reported by Thienemann, who collected them only between 1.0 and 2.0 m. The maximum concentration on the bottom of the inlet bay was recorded at 1.0 m. (4928 per sq. m.) on February 26, 1955. The cocoons averaged 4.0 mm. long and 1.6 mm. wide (i.e., somewhat smaller than those described by Thienemann). They are weakly concave along the mid-line, and the ends are approximately semicircular in shape (fig.). The larvae are bent at 180° at the mid-point of their length, and the head and caudal regions occupy the same end of the cocoon.

A number of cocoons measuring only 1.4 mm. in length were also collected in the samples, so that apparently all three larval stages have the ability to build overwintering cocoons. The cocoon is closed on all sides and is constructed of silk-like oral secretions to which bits of inorganic detritus and diatoms adhere. Their color is dark yellow to brown.

On the basis of near-bottom water temperature data, larvae of *E. subtendens* start to build cocoons shortly after the minimum daily water temperature falls to 10° and the mean daily water temperature falls below 13°. This latter temperature was first recorded in the inlet bay on November 20, 1954. Eight days later cocoons were found in the dredgings. Conversely, the mean critical temperature for reactivation of the larvae in the spring must lie between 5 and 9°. Over 50 per cent of the larvae had become active on April 22, 1955, when the mean daily water temperature was 5.3°, and over 70 per cent were active by May 8, 1955, when the mean temperature had increased to 9.3°.

Representative specimens are in the collections of the United States National Museum.

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New Longicorn Beetles from Texas (Coleoptera, Cerambycidae)

By E. Gorton Linsley, University of California, Berkeley

The following species are described in order that the names may be available in connection with another study.

Heterachthes texanus Linsley, new species

Male: Form slender, small; integument uniformly dark brown, surface subglabrous except for very long erect pale setae which are longer than greatest width of femora; elytra without pale markings. *Head* coarsely, irregularly punctate between eyes; antennae very heavy, exceeding elytral apices by about three segments, segments three to six greatly swollen, thicker than scape, apically ciliate but not carinate, segments seven to eleven filiform. *Pronotum* dull, coarsely, rugosely punctate, a little more than one and one-half times as long as basal width; prosternum shining, subglabrous; metasternum shining, glabrous practically impunctate. *Elytra* dullish, with scattered coarse punctures bearing very long setae; apices separately rounded. *Legs* moderate; femora clavate, with scattered long erect setae. *Abdomen* shining, subglabrous, almost impunctate. Length, 4.5 mm.

Holotype male (Calif. Acad. Sciences, Entom.), from the Chizos Mts., Big Bend, Texas, July 5, 1942 (E. C. Van Dyke).

This is a small, obscure species, easily known by the uniform dull coloration above, shining impunctate ventral surface, extremely heavy basal segments of the antennae and the very long erect setae of the elytra and legs.

Crossidius inflaticollis Linsley, new species

Male: Form large, subparallel; integument dull, red, antennae, legs, scutellum, and sterna of meso- and metathorax black, elytra with a broad parallel-sided anteriorly pointed bluish area, humeri narrowly black. *Head* densely, coarsely punctate above;

antennae eleven-segmented, exceeding elytral apices by about three segments, basal segments sparsely ciliate internally, finely punctate, eleventh segment elongate, vaguely appendiculate. *Pronotum* large, a little narrower than elytra (11:12), less than one and one-half times as broad as long (11:8), sides tumid or very feebly subtuberculate, surface uneven, impressed on each side of disk, coarsely, shallowly, densely and somewhat confluently punctate, pubescence long, erect, moderately dense; prosternum finely densely punctate with coarser punctures superimposed, densely clothed with long erect pale hairs, meso- and metasterna finely, densely punctate. *Elytra* about two and one-third times as long as basal width, sides subparallel, surface thinly clothed with moderately long suberect hairs, closely and rather coarsely punctate but the basal punctures distinctly smaller than those of pronotum, becoming finer, denser apically; apices sinuate truncate, inner and outer angles distinct but not produced. *Legs* finely punctate, thinly clothed with suberect pale hairs. *Abdomen* very finely and densely punctate, clothed with long, pale, suberect hairs. Length, 18.5 mm.

Holotype male (Calif. Acad. Sciences, Entom.), from Chinati Mt., Presidio Co., TEXAS, October 29, 1928 (E. R. Tinkham).

This species superficially resembles those of the *corallinus-cruentus* group but may be recognized at once by the large pronotum without a prominent lateral tubercle and the long pubescence of the upper and lower surfaces. The blue area of the elytra is unusually extensive for males in this genus.

Amannus atriplicis Linsley, new species

Male: Form robust; integument black, elytra testaceous, basal margin and suture black, median black vitta extending from near apex to humerus; pubescence dense, pale. *Head* rather finely punctate at base, clothed with moderately long, appressed hairs; antennae twelve-segmented, exceeding elytral apices by from two to three segments, third segment a little longer than fourth, fourth segment subequal to fifth, segments five to eleven successively slightly shorter, twelfth segment distinctly shorter than eleventh, attenuate, segments three to seven carinate in-

ternally. *Pronotum* nearly one and one-third times as wide as long, sides obtusely rounded or subtuberculate, surface moderately coarsely, densely punctate, densely clothed with long appressed hairs which obscure the surface sculpture; scutellum densely clothed with long appressed hairs; pro-, meso-, and metasterna densely clothed with long, appressed pubescence which obscures the surface. *Elytra* about two and one-fourth times as long as basal width, finely costate; surface rather tate, clothed with suberect pale hairs which are a little longer coarsely, densely, contiguously and somewhat confluently puncnear base; apices rounded to suture, very slightly dehiscent. *Legs* slender; femora clothed with long appressed pubescence. *Abdomen* very densely clothed with long appressed hairs. Length, 10.5 mm.

Female: Antennae not quite reaching to base of abdomen; abdomen with apical margins of sternites evident but not broadly arcuately denuded. Length, 9–12 mm.

Holotype male, *allotype* female and two *paratypes,* male and female (United States National Museum), from Presidio, TEXAS, May 7, 1944, on *Atriplex canescens* (no. 44–12184), collected by J. H. Russell.

This species is related to *A. vittiger* Le Conte, but is a little larger and more robust with the elytra only about two and one-fourth times as long as basal width, the pubescence of the pronotum appressed, rather than erect, and obscuring the surface, and the abdomen of the female without broadly arcuate denuded apical margins on the sternites. The elytra are margined with black at the base and along the suture and the median black vitta attains the humerus.

New Records of Mammal-Lice Associations [1]

By Carlo M. Ignoffo

Eight living lice collected from a freshly killed cottontail rabbit, *Sylvilagus audubonii* (Baird), in the Great Salt Lake Desert region south of the Cedar Mountains, Tooele County, Utah, were identified as *Haemodipsus setoni* Ewing. Although Ferris [2] mentions collecting this louse "from an undetermined species of cottontail presumably a species of *Sylvilagus* . . . from the state of Montana," this is believed to be the first definite record of this association.

Other new records of lice parasitizing mammals from this same area are:

Neohaematopinus laeviusculus (Grube)
Townsend ground squirrel, *Citellus townsendii* (Bachman)

Neohaematopinus citellinus Ferris
Antelope ground squirrel, *Citellus leucurus* (Merriam)

Hopopleura hesperomydis (Osborn)
Pinyon mouse, *Peromyscus truei* (Shufeldt)
Canyon mouse, *Peromyscus crinitus* (Merriam)

Hopopleura arboricola Kellogg and Ferris
Cliff chipmunk, *Eutamias dorsalis* (Baird)
Least chipmunk, *Eutamias minimus* (Bachman)

Fahrenholzia reducta Ferris
Great Basin pocket mouse, *Perognathus parvus* (Peale)

Fahrenholzia pinnata Kellogg and Ferris
Ord kangaroo rat, *Dipodomys ordii* Woodhouse
Little pocket mouse, *Perognathus longimembris* (Coues)

[1] This work was supported by U. S. Army Chemical Corps contract, No. DA-18-064-CML-2639, with the University of Utah.

[2] Ferris, G. F. 1951. The Sucking Lice, Mem. Pacific Coast Ent. Soc., 1: 179.

The Weight of Puparia of Rhagoletis basiola (O. S.). (Trypetidae, Diptera)

By W. V. Balduf, Urbana, Illinois

Introduction

In a previous investigation (in press), I found that the puparia of this rose hip fly varied widely in length from 3.0 to 6.9 mm. and in ratio of length to diameter from 2.00:1.00 to 2.74:1.00. Thus, curiosity prompted me to inquire briefly also into the nature of their variation in weight. The 222 individuals involved here developed from larvae in the hips of *Rosa blanda* and *R. carolina* near Chetek, Wisconsin. Whereas the hips were picked on September 5, 1950, pupariation of the materials concerned here occurred at Urbana, Illinois, on September 17 to 22 and 26 to 28. The nine daily samples were weighed each day and kept separated in shell vials stored out-of-doors but sheltered from direct sun and rain.

Results

The puparia were found to vary in two ways: (1) in their initial weights taken at the time of pupariation, i.e., within 24 hours after the mature larvae emerged from the hips, and (2) in the subsequent period of 35 to 40 days during which they were subjected to "dry" and wet conditions, alternately.

Original Weights. The initial weight of the 222 puparia totalled 3.310 grams, which gave an average value of .0149 gr. per individual. The nine daily samples consisted of 9 to 33 puparia. The initial average weight per puparium for these samples was as follows, in chronological order: .0179 (Sept. 17), .0166, .0155, .0159, .0133, .0145, .0167, .0141 and .0096 (Sept. 28). These data, in general, show a tendency of the puparia to decrease gradually in weight from the beginning to the end of the over-all period of pupariation, September 17 to 28. One condition that probably contributed to this decline was the deterioration of the stored hips which formed the food of the advanced larval instars from September 5 to 28. However,

some hips remained in a well-preserved state, while others deteriorated to varying extents. These differences in the condition of the hips may well explain the chronological irregularity of the observed decline in weight of the puparia.

Parasitism probably was another factor in the observed decline. The hymenopterous endoparasites, *Halticoptera rosae* Burks, *Opius baldufi* Mues. and *O. rosicola* Mues. attacked this fly significantly in several years at Chetek. However, the present purparia were not dissected to learn the rate of incidence of the parasites, nor the manner in which they affected the weights of the hosts.

Weights and Humidity. Because some puparia of all but two of the nine samples died in the course of the weighings, and because such fatalities probably prejudice the results of the tests, I am presenting here only the data for the two whole samples. Yet, the excluded samples have some informational value since they reflect the same general type of variations as the included two, namely, (1) a decided increase in weight with exposure to water, and (2) a marked decrease in weight under "dry" conditions.

The two samples for which I have complete records involve 56 puparia. On the days of pupariation, they were placed on cotton in normally dry atmosphere and weighed daily until they ceased to lose weight. During this period of 17 to 20 days, their combined initial or original weight—.9404 gr., fell off to .6990 gr., which represents a decline of 25.67 per cent.

Next, the dry puparia were transferred at once to a water-saturated wad of cotton in a vial. At the end of seven days, their weight had levelled off and had increased from .6990 gr. to .8248, i.e., 15.26 per cent. However, they still were 12.29 per cent short of their initial weight of .9404 gr.

Now the puparia were again kept on air-dry cotton until the daily records showed their weight had again become constant. This condition had developed on the twelfth day, when they weighed .6903 gr. This figure represents a loss of 16.31 per cent from the previous saturated weight of .8248 gr., and of 26.60 per cent from the initial weight of .9404 gr.

Deductions

The observed pattern of changes suggests the following deductions:

First, the living puparia have the capacity to vary sharply in weight, the increases noted here being due to the absorption of environmental water, and the decreases to the evaporation of body fluids through the cuticla.

Second, the fact that the weight achieved at the termination of the seven-day wet period fell short, by 12.29 per cent of the initial weight, indicates the puparia tend to lose some of their capacity to regain by absorption. However, since mortality in puparia is not readily detected, it is possible that some of this loss of ability to regain all the previously lost weight was apparent, not real.

Third, a change in color, texture and specific gravity accompanies the variations in weight that arise from alternate wetting and drying. When newly puparíated, the puparia were normally dark ocherous and rubbery, tough; when they reached the extreme of dryness imposed in the treatment, they had turned pale stramineous, rigid and fragile. The darker flexible condition is restored with wetting. Dry puparia float lightly on water; wet ones float deeply.

Fourth, these variations in color, texture and weight, or specific gravity, are extrinsic and inconstant, hence have only negative taxonomic significance for segregation of species in the puparial stage.

Distribution and Variation of the Ant Formica dakotensis Emery

By W. L. Brown, Jr., Museum of Comparative Zoology, Harvard University

Our understanding of *Formica dakotensis* Emery has been advanced considerably by Creighton (1950, Bull. Mus. Comp. Zool. 104: 480, 484–486) who cites data and references I need not repeat here. The easternmost record for *dakotensis,* doubted

by Creighton, was based on a mixed series from Digby, Nova Scotia (J. Russell leg., MCZ), consisting of eight workers mounted on two pins. By coincidence, the top two workers on each pin happened to be *F. subnuda* Emery, the bottom two on each pin, *F. dakotensis*. Evidently Creighton saw these top workers only, and assumed that the pins had been misplaced in a group of the wrong species; at my first glance, I also made the assumption that the series was homogeneous *subnuda,* and it was only after an intensive study of *subnuda* was begun that I found that instead it was a mixture of these two superficially similar species. There seems to be no reason any longer to doubt that both species occur as far east as Nova Scotia, especially in view of the considerable range extensions that are reported next below for *F. dakotensis.*

Variation in *dakotensis* includes a "race *montigena,*" said to differ by having erect hairs on petiolar margin and gula. A series from Bluff Prairie, London, Ohio (C. H. Kennedy leg.), has from 3–5 erect hairs on the dorsal petiolar border; the Nova Scotia specimens have 1–5 per border.

A long series from Fairbanks, Alaska (W. Briggs leg.), is like the eastern lots in lacking gular hairs entirely, and generally has fewer on the petiolar border, often lacking hairs here completely. The samples with both gular and petiolar hairs erect are found in the Colorado Rockies, Idaho, Montana, Alberta Rockies and British Columbia, but there is as much variation in series from Alberta and Montana as in the rest of the distribution combined; some series from this region are extreme "typical" *dakotensis,* others are extreme *montigena,* and still others are intergradient and/or mixtures of the extremes.

Since the distributional patterns of the gular hairs and the petiolar hairs are strongly discordant, it is obvious that they cannot be used together to define geographical races. Considered alone, the gular hairs are characteristic in Colorado, but are less so farther north. The evidence for intergradation in this character alone is not quite good enough to rule out the possibility that *montigena* is a Rocky Mountain sibling that meets the east-west range of *dakotensis* in Montana and Alberta. The few females available do not provide very good support for

this hypothesis, although the considerable variation they show may fall into line when better material comes into evidence. Everything considered, it seems likely at this time that *montigena* should pass into the synonymy of *dakotensis;* at least, the burden of proof should fall on those who wish to maintain *montigena* as an independent taxon.

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Greatly increased production costs have finally made necessary a change in policy as regards separates of articles in ENTOMOLOGICAL NEWS. Faced with a choice of having the printer almost double the prices on reprints purchased by authors, or of ourselves paying the costs of the 25 gratis copies furnished, we have decided on the latter course. We shall continue the old custom of accepting suitable articles from any author, and will publish these without cost to the author. However, the author will not be entitled to the usual 25 gratis separates unless he is a member of our Society. Every author may, of course, order reprints from the printer, and the prices of these are very reasonable considering present day costs and the high quality of the work.

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This column is intended only for wants and exchanges, not for advertisements of goods for sale or services rendered. Notices not exceeding three lines free to subscribers.

These notices are continued as long as our limited space will allow; the new ones are added at the end of the column, and, only when necessary those at the top (being longest in) are discontinued.

Conopidae of the World wanted. Will pay 10¢ to $1.00 for pinned and labelled specimens. S. Camras, 4407 N. Milwaukee Ave., Chicago 30, Illinois.

Anisoptera—Nearctic sp. wanted for exchange, espec. Ophiog., Arigom., Aeschna, Neurocor., Somatoc., Cordulia, Dorocor., Leucor. R. D. Cuyler, Dept. of Entomology, N. C. State College, Raleign, N. C.

Bembicini and Stizini (Hym., Sphec.) of New World wanted for revis. study. Will return upon request or at end of project. James E. Gillaspy, Dept. of Zoology, Univ. Texas, Austin 12, Texas.

Agapema galbina. Will exchange cocoons of this moth for nature books. E. Frizzell, Route 4, Box 96, San Benito, Texas.

Tenebrionidae of the World wanted, in exchange for insects of Argentina and neighboring countries. Horacio J. Molinari, Av. Lib. Gral. San Martin 55, Acassuso (Buenos Aires), Rep. Argentina.

Butterflies. Wish to exchange specimens for Japanese species. Please write to Ichiro Nakamura (Boy, age 16), 26 Aza-Nishiyama Obayashi Takarazuka-shi, Hyogo-Ken, Japan.

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THE NEOTROPICAL SPECIES OF THE 'SUBGENUS AESCHNA' SENSU SELYSII 1883 (Odonata)

By Philip P. Calvert

This paper presents an account of the Neotropical species referred by de Selys in 1883 to his subgenus *Aeschna* and of some species unknown to him. His subgenus is here divided into three genera, *Aeschna, Coryphaeschna,* and *Castoraeschna, Aeshna* in its turn being subdivided into the subgenera *Aeschna, Hesperaeschna, Rhionaeschna, Schizuraeschna, Marmaraeschna* and *Neureclipa.* These five subgenera include 2, 15, 1, 3, 4 and 5 species and subspecies respectively. *Coryphaeschna* embraces 9 species and subspecies, *Castoraeschna* 5. Larvae of 2 species of *Hesperaeschna,* 1 species of *Schizuraeschna,* 1 species of *Neureclipa* and 6 species of *Coryphaeschna* are described and figured. Generalities are discussed under the headings: Relationships of the Neotropical Aeshnas to the North American fossils; Relations of the South American Aeshnas to the Palaearctic and Australian species; The geological age and geographical distribution of the ancestors of the Odonata and of the Mammalia; Relations of the Neotropical Aeshnas to each other; The seasonal distribution of the Neotropical species of Aeshna. Forty plates in black and white illustrate the structural and colorational features of the adults, seven those of the larvae. Nineteen tables show the variations in size and in venation of the adults. Six maps show the geographic distribution of all the species concerned. There is an alphabetical index of species, subgenera, genera, authors quoted, and topics.

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